The State of Montana
National Laboratory System
Antimicrobial Susceptibility Testing
Survey 2007

Prepared by
Montana Department of Public
Health and Human Services
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MONTANA
Department of Public Health & Human Services

Introduction

Antimicrobial resistance is a significant health problem. In Montana, prior to 2007, there were three antimicrobial susceptibility testing (AST) surveys that were written and administered in Montana. For all of these surveys, data was requested from the previous year calendar year. In April 2007, the Montana Department of Public Health and Human Services, Public Health Laboratory administered an additional AST survey as part of a regional project involving Montana, North Dakota, South Dakota, and Wyoming. This regional project is a component of the National Laboratory System (NLS) Initiative to Integrate Clinical Laboratories into Public Health Testing. The primary goal of the NLS Initiative is to enhance testing and reporting practices of antimicrobial susceptibility testing (AST) in laboratories providing services in Montana, North Dakota, South Dakota, and Wyoming. The objectives for and activities funded by the NLS Initiative are intended to increase the knowledge base of clinical laboratory professionals while improving their ability to conduct public health-related testing and reporting in these frontier states. The information gathered was from calendar year 2006 and was used to assess the status of AST practices, determine susceptibility trends across Montana and the Northern Plains region, and to identify educational opportunities for the practical application of AST standards. The three antimicrobial susceptibility testing surveys that were analyzed in Montana in the past (1997, 2003, and 2006) were used for comparison. Although the previous surveys were not administered in ND, SD, or WY, they may provide valuable data not just for Montana, but for all states that share similar demographics

Sixty Montana clinical laboratories determined to provide microbiology testing were solicited for participation. Of these 60, 38 laboratories (63%) responded to the 2007 survey. This report summarizes the results of that survey, and discusses the findings. In addition, the 2006 antibiogram data requested in the 2007 survey was analyzed and a statewide antibiogram report was made available to Montana laboratories in February 2008. This composite antibiogram report, along with 2002 and 2006 reports, is posted at the Montana Antibiotic Resistance Awareness (MARA) website at http://www.dphhs.mt.gov/PHSD/MARA/mara-news.shtml

Background

Antimicrobial resistance is a major public health concern because the prevalence in recent years has rapidly increased. Improper treatment of infections due to resistance to conventionally prescribed antimicrobials has led to increased morbidity and mortality. Lack of standardization in antimicrobial susceptibility testing practices can result in misinterpretation of data and inappropriate prescribing of empiric antimicrobial therapy. Alternatively, consistently accurate data can help achieve successful remedy of an infection, and also provide clinicians and health professionals with confidence in their therapeutic prescribing and their ability to question potentially misleading anecdotal reports of antibiotic resistance.[1] As the emergence and spread of antimicrobial

resistance continues to rise, antimicrobial resistance has been deemed one of the world's most pressing public health problems.

The major goal of the National Laboratory System is to develop a means for clinical laboratories to better engage in conducting public health related testing and to participate in the public health system. This assessment allowed the Montana Public Health Laboratory (MTPHL) to identify areas of concern regarding antimicrobial susceptibility testing (AST) and to provide targeted training in order to promote and assist in practical applications of AST standards, and increase adherence to voluntary guidelines. Surveillance of antimicrobial resistance (AMR) is critical in providing an early warning of emerging problems, monitoring changing patterns of resistance, and targeting and evaluating prevention and control measures. Another goal is to identify the barriers to laboratories unable to participate in the survey process and to address these barriers in an effort to gain better participation in 2009.

The following report presents the results of the antimicrobial susceptibility testing survey conducted by the National Laboratory System in conjunction with Montana Public Health Laboratory (MTPHL) in 2007. The purpose of this AST survey was to: (1) assess the status of AST practices within Montana, and compare data within the four state consortium; (2) to determine susceptibility trends across Montana and the Northern Plains region; and (3) identify educational opportunities for the practical application of AST standards.

Methods

Survey Design and Implementation

The questionnaire used in 2007 was completely revised from the previous three questionnaires. Individuals involved in the development of this survey included laboratory representatives, epidemiology staff, and antimicrobial resistance (AR) coordinators from Montana and each state in the consortium, as well as representatives from Wisconsin, Nebraska, and the Centers for Disease Control and Prevention (CDC). The survey was divided into several distinct subject areas including: Demographics, Practices, Antibiograms, Training, Methodology, and Evaluation and was designed to be distributed electronically, although hard copies were provided by request.

The survey was distributed on April 25, 2007 to all accredited clinical laboratories performing antimicrobial susceptibility testing in Montana, and requested AST for calendar year (CY) 2006. In addition to requesting information about AST methodology, referral practices, and antibiogram data, the 2007 survey also contained a number of “scenario” type questions developed to assess knowledge of CLSI guidelines.

The questionnaire was preceded by an "announcement of opportunity" letter and subsequent phone calls to each laboratory in order to confirm contact information. Additionally, a follow-up phone contact was used to clarify any questions and facilitate the return of the questionnaire by the end of August 2007. Follow-up calls were made to all facilities that did not respond in an effort to help them through the survey process and increase participation.

Analysis of data

Several laboratories were unable to return the survey electronically due to technical limitations, so hardcopies were provided and the data were either mailed or faxed back. Follow-up calls were made to facilities if survey questions were unanswered or if answers were unclear. In addition, data entry rules were created to address translation problems and to standardize the data entry process. Data from the questionnaire were compiled in Access software and descriptive statistics were generated using Access and SAS. The antibiogram data were compiled and calculated using Microsoft Excel.

Results and Discussion

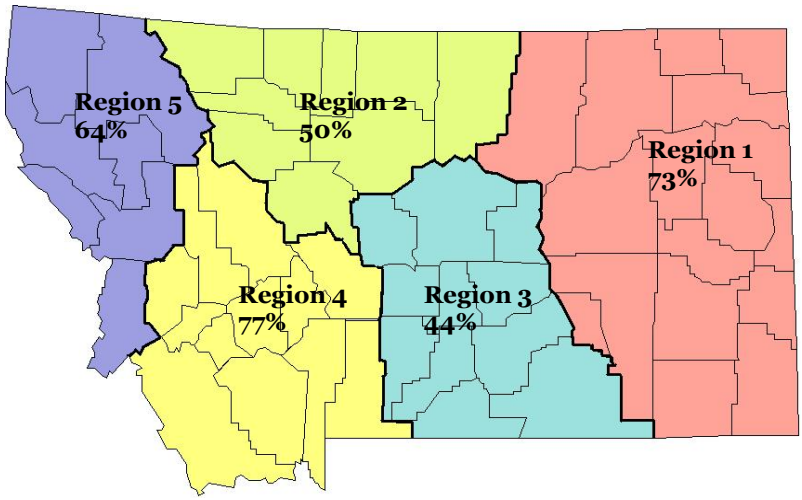
Laboratory Response

Surveys were sent electronically to the 60 clinical laboratories that perform antimicrobial susceptibility testing in Montana. Thirty-eight (63%) of those returned all or a portion of the survey. Twenty-five (66%) of the 38 laboratories provided antibiogram data. All of the eleven largest laboratories in the Montana submitted surveys and antibiograms. As a result, this survey captured a major portion of the antimicrobial testing performed within the state. The responding laboratories were distributed relatively evenly across Montana. (Figure 1)

Figure 1: Percentage of laboratories responding to the 2006 Antimicrobial Susceptibility Survey, by Montana Health Planning Region

Number of laboratories surveyed and respondents per Montana Health Planning Region

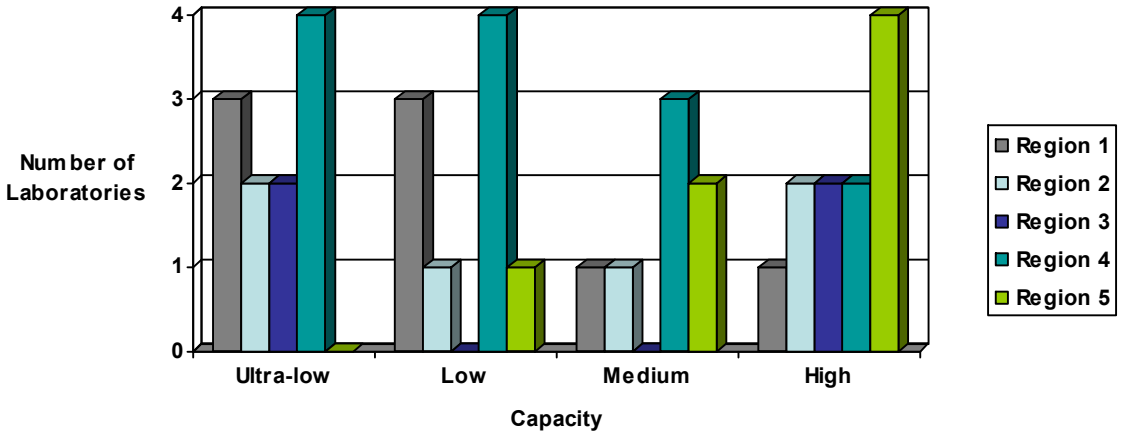
	# Labs Surveyed	# Labs Responded
Region 1	11	8
Region 2	12	6
Region 3	9	4
Region 4	17	13
Region 5	11	7



Data were also stratified by laboratory capacity using the total number of AST performed in 2006. The categories used are: Ultra-Low (0-250 tests), Low (251-600 tests), Medium (601-1500 tests), and High (1501-9000 tests). Eleven of the 38 (29%) responding laboratories were categorized as Ultra-low, 9 (24%) as Low, 7(18%) as Medium, and 11(29%) as High.

When respondents were stratified by capacity in each Healthcare Planning Region, Region 4 had the largest number of Ultra-Low and Low capacity laboratories and Region 5 had the largest number of High capacity laboratories. (Figure 2)

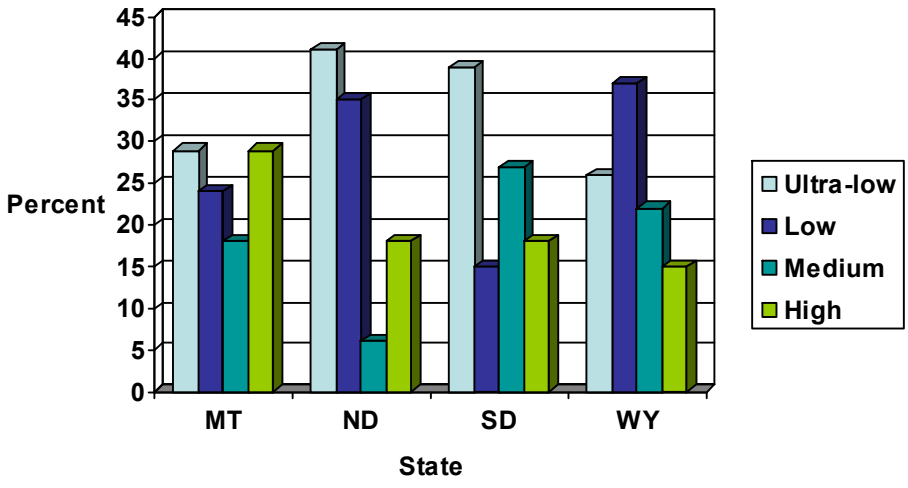
Figure 2 **Capacity of Laboratories Responding per Healthcare Region in Montana**



The responding 38 laboratories reported they performed a total of 58,230 antimicrobial susceptibility tests in 2006. The total number of tests performed in individual laboratories ranged from 0 to 8,600 tests, with 24 (63%) laboratories performing less than 1000 tests.

Figure 3 illustrates the percent of laboratories in capacity categories for each state in the Northern Plains consortium. In all states, the majority of laboratories fit into the Ultra-low and Low categories (less than 600 tests per year).

Figure 3 **Percent of laboratories in capacity categories for Northern Plains region**



Demographics

The demographics portion helped differentiate the participating laboratories by type, size, referral patterns, staff and population served. In 2006, twenty-six of the 38 (68%) responding laboratories were Community (City or County) non-profit hospitals. The remainder of the respondents fit into a variety of categories. Twenty-nine (76%) of the hospital laboratories were considered small and the corresponding hospitals had fewer than 200 beds. Of these hospital laboratories, 27 (71%) described themselves as serving a critical access hospital.

The 38 responding laboratories were certified by the following agencies: 23 (61%) by CLIA Certificate of Compliance Laboratory (CMS), 11 (29%) by College of American Pathologists (CAP), 10 (26%) by Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and 7 (18%) by Clinical Outpatient Laboratory Association (COLA). Since multiple answers were possible, total numbers do not equal 38.

In assessing referral patterns, twelve (32%) of the responding laboratories referred routine bacterial specimens for AST testing in 2006, while 13 (34%) of laboratories accepted routine specimens from other laboratories for AST testing.

Twenty-one (55%) responding laboratories characterized their primary population of service to be a small city plus rural population and 30 (79%) reported that Native Americans were less than 25% of the population they served. The size of the primary populations these laboratories served is summarized below. (Figure 4)

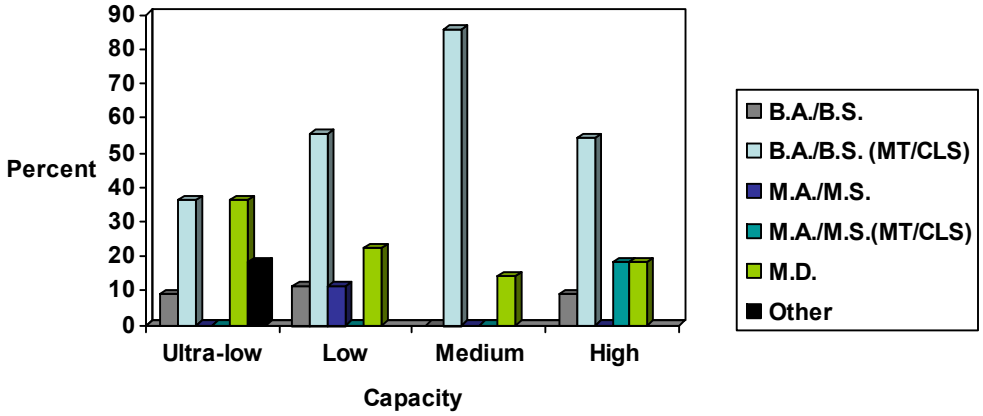
Figure 4 **Size of primary populations served by laboratories responding to the 2006 AST survey**

Population	# of responding labs	Percentage
Fewer than 4,999	12	32
5,000 -9,999	5	13
10,000-24,999	7	18
25,000-49,999	8	21
50,000-99,999	3	8
100,000-500,000	3	8
More than 500,000	0	0

Seventeen of the 38 (45%) responding laboratories served a population of less than 10,000; 18 (47%) served populations between 10,000 and 99,999, and 6 (16%) laboratories served a population between 100,000 and 500,000.

The qualifications of laboratory staff members during the year 2006 were also assessed. In 21 of the 38 (55%) responding laboratories, the highest degree awarded to the Microbiology Laboratory Director was a B.A./B.S. (MT/CLS). Nine (24%) had a Microbiology Laboratory Director with an M.D., 2 (5%) with a M.A /M.S (MT/CLS), 1 (3%) with a M.A./M.S, 3 (8%) with a B.A./B.S. and 2 (5%) laboratories did not have a Microbiology Laboratory Director at this time. (Figure 5)

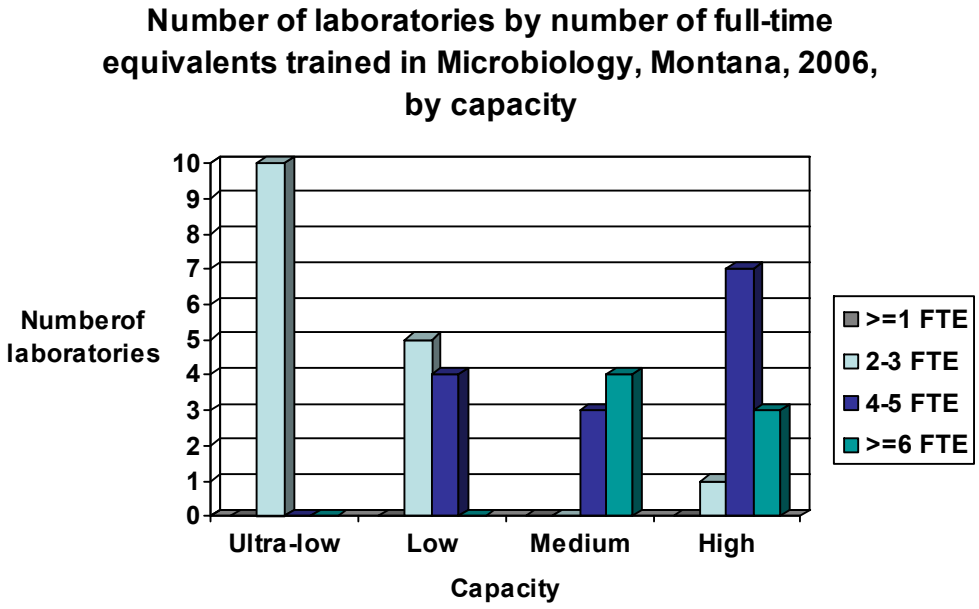
Figure 5 **The Highest Degree Awarded to Microbiology Laboratory Directors, 2006, Montana, by capacity**



Thirty-three (87%) of the 38 responding laboratories answered that the majority of their bench staff had a B.A./B.S. (MT/CLS) as their highest educational background. Twenty-two (58%) required a B.A./B.S. (MT/CLS) as the minimal required educational background, 10 (26%) a minimum of an A.A/A.S. (MLT/CLT), 4 (11%) a minimum of a B.A./B.S., and 1 (3%) a minimum of an A.A/A.S.

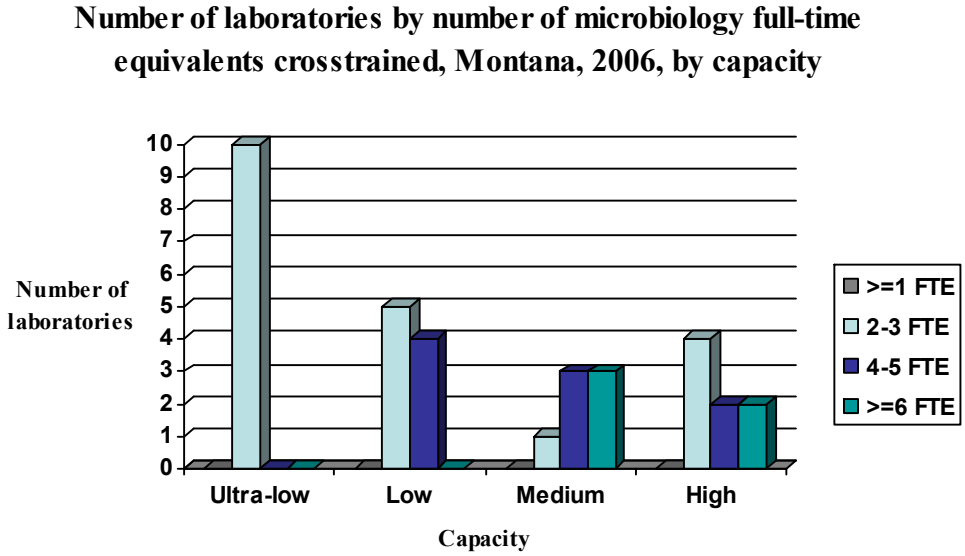
Thirty-seven of the 38 (97%) laboratories had more than one full-time equivalent (FTE) staff person trained to perform microbiology. When stratified by capacity, the Ultra-low and Low categories which performed fewer ASTs, had fewer FTEs trained in Microbiology than the Medium and High categories. (Figure 6)

Figure 6



Of these 37 laboratories, 34 (92%) had microbiology FTEs that are also crosstrained in other areas of the laboratory. When stratified by capacity, the number of Microbiology FTEs trained in other areas of the laboratory showed a similar pattern to those trained to perform AST. In the Ultra-low and Low categories, all of the Microbiology FTEs were crosstrained. The Medium and High category laboratories differed in the number of Microbiology FTEs that were crosstrained, indicating that some FTEs were specifically dedicated to Microbiology. This data indicated that no FTEs are dedicated to Microbiology in the Ultra-low and low capacities. (Figure 7)

Figure 7



Practices

Clinical laboratories were assessed for their adherence to recommended AST testing guidelines. The Clinical and Laboratory Standards Institute (CLSI) is an organization that promotes the development and use of voluntary consensus standards and guidelines within the health care community. These documents provide invaluable tools that allow distinct constituencies to meet their health care responsibilities with efficiency, effectiveness, and global acceptance.[2] Clinicians depend heavily on information from the clinical microbiology laboratory for treatment of their seriously ill patients. The clinical importance of antimicrobial susceptibility test results requires that these tests be done under optimal conditions and that laboratories have the capability to provide results for the newest antimicrobial agents. By adhering to various testing and disease reporting guidelines, clinical laboratories are better able to increase their ability to conduct appropriate public health related testing and participate in the public health system.

The 2007 CLSI AST guidelines (M100-S17, M2-A9, M7-A7, and M39-A2) were purchased and distributed upon request to all laboratories performing AST testing. These standards were mailed in February 2007, prior to the questionnaire.

This survey revealed 28 of the 38 (74%) responding laboratories performing AST are following the Clinical and Laboratory Standards Institute (CLSI) M100 standards for antimicrobial susceptibility testing, 3 (8%) were not following the guidelines, and 7 (19%) did not know. (Figure 8) Nineteen of the 28 (68%) laboratories were following the M100-S17 (2007) CLSI guidelines, 8 (29%) were following M100-S16 (2006), and 1 (4%) was following M100-S15 (2005). These data indicate that 27 (96%) of the 28 laboratories were following the most current guidelines.

Figure 8

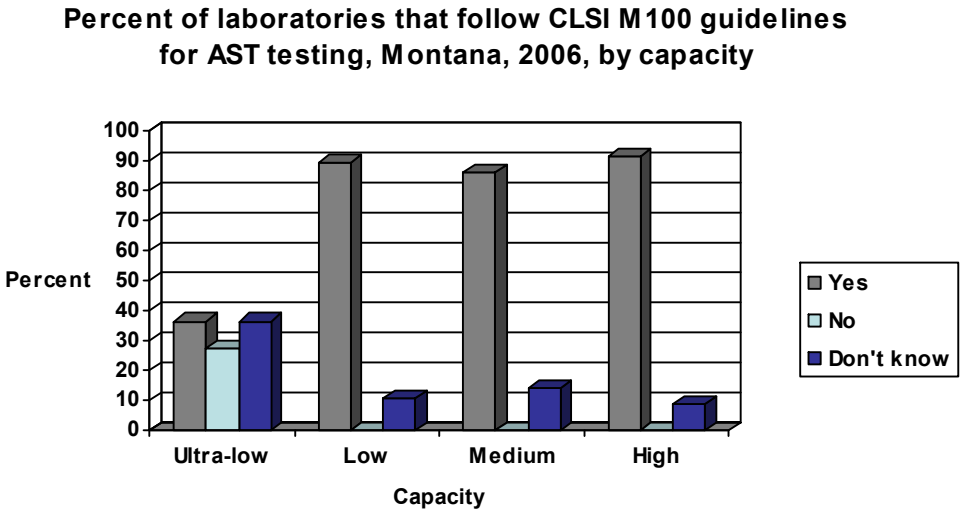
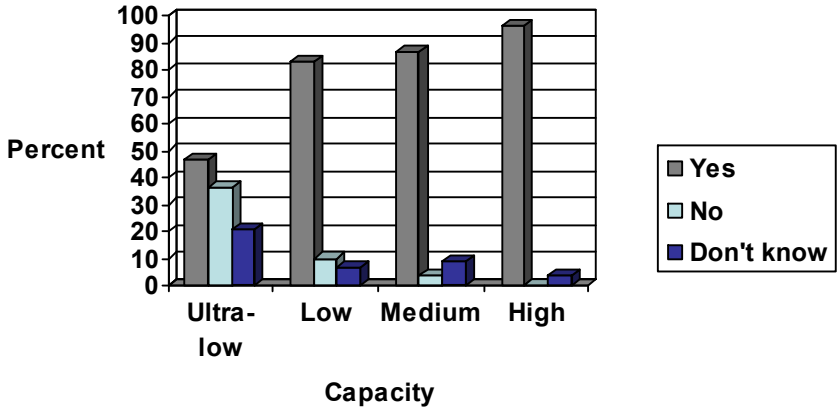


Figure 9 represents the proportion of laboratories that follow the CLSI M100 AST guidelines in the Northern Plains region. The majority of laboratories in all four states do follow these guidelines for AST, although there are several laboratories, mostly ultra-low or low capacity laboratories that do not follow or do not know.

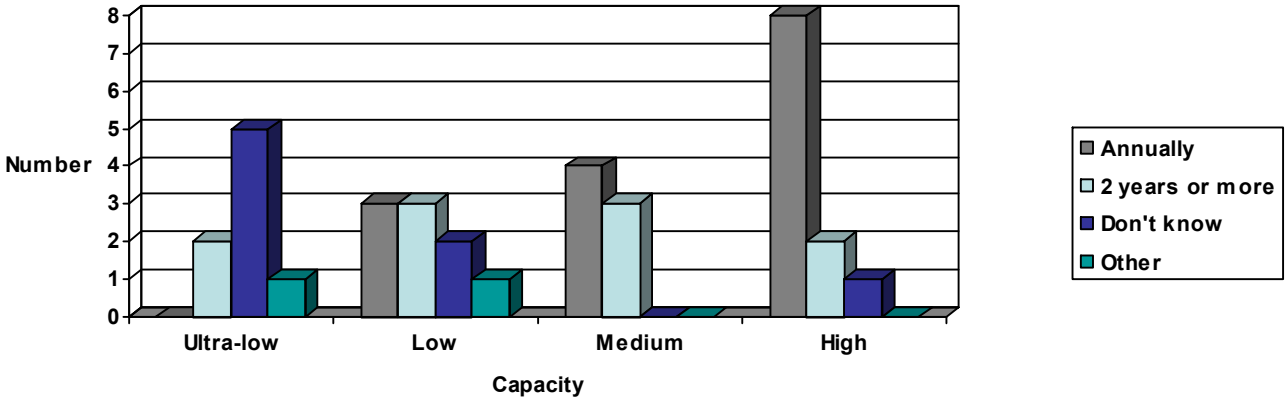
Figure 9 **Percent of laboratories in the Northern Plains region that follow CLSI M100 guidelines, by capacity**



When assessing how the Montana clinical laboratories obtain their CLSI guidelines, 12 (34%) of the 35 responding laboratories had their CLSI guidelines purchased by an institution, 4 (11%) had guidelines provided by a state agency, 5 (14%) had guidelines provided by a sales representative, 6 (17%) did not obtain CLSI guidelines yearly, 3 (8%) did not know, and 5 (14%) answered "other".

Fifteen of 35 (43%) responding laboratories in Montana received CLSI guidelines yearly, 4 (11%) received them every 2 years, 6 (17%) received them every three years, 5 (14%) did not know, and 2 (6%) answered "other". The higher volume laboratories performing more ASTs were more likely to obtain CLSI guidelines annually. (Figure 10)

Figure 10 **Frequency of laboratories obtaining CLSI guidleines, Montana, 2006, by capacity**



For the 24 laboratories that do not or are unable to obtain CLSI guidelines yearly, the primary factor preventing acquisition was lack of funds for purchasing (6/24, 25%). Other factors were lack of time for reviewing and implementing updated guidelines and that the guidelines are too complex and did not apply to the laboratory's workload (both 17% of responses). Additional responses included not realizing CLSI guidelines came out yearly, that no one is in charge of ordering CLSI documents, that the guidelines did not change enough to warrant spending money each year, and staff turnover.

When looking at whether or not laboratories have a designated person to integrate changes according to the CLSI guidelines and whether or not this affects how timely AST practice changes are made, it was found that 30 (86%) of 35 responding laboratories did have a designated person to integrate the CLSI guideline changes and 23 (77%) did implement the AST practice changes in a timely manner, while 7 (20%) did not.
The laboratory supervisor or microbiology supervisor was responsible for integrating the CLSI guidelines into AST practices in 24 (69%) of the 35 responding laboratories. Three (9%) had a laboratory manager responsible for guideline integration, 2 (6%) had a bench technologist responsible for guideline integration, 4 (11%) had no specific person responsible for this task and one (3%) laboratory varied from year to year.

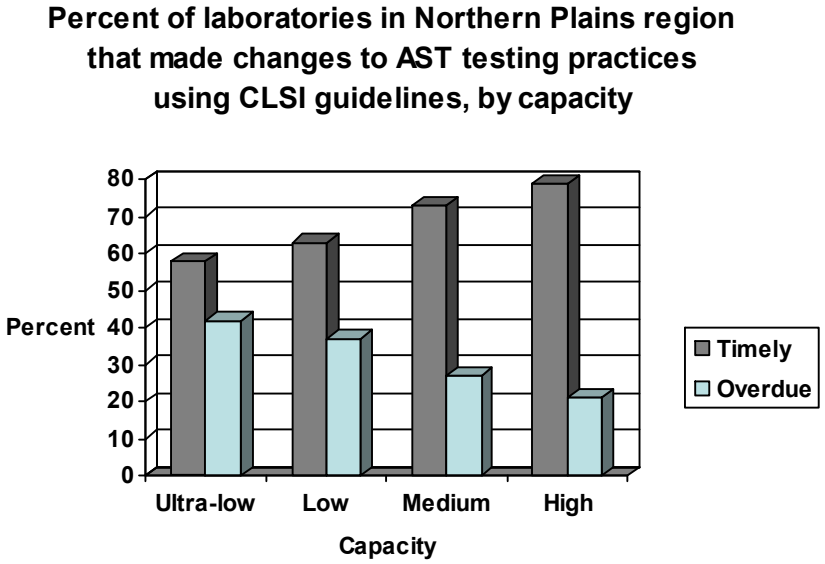
Over one third of the laboratories (34%) did not perceive any challenges in implementing the CSLI guidelines and were able to make all of the necessary changes. For those that did have challenges, the top challenge was lack of time for implementing required changes. This was cited by about one third of the respondents (11, 32%). Additional responses included not knowing how to prioritize the changes that need to be made, not having a person responsible for suggesting and implementing changes, lack of funds, lack of laboratory staff, and lack of support from administration/decision makers.

To determine the timeliness of how changes are made, 15 (43%) of the 35 responding laboratories had implemented changes within the last 6 months, 10 (29%) implemented changes within the last calendar year, 4 (11%) within the last 2 years, 1 (3%) more than 2 years ago, 1 (3%) no changes had been made, and 4 (11%) did not know when the last changes were made. When laboratories were stratified by capacity, there was no apparent difference between laboratories implementing timely changes recommended by the CLSI guidelines by AST volume. Altogether 25 (71%) of the 35 responding laboratories did make timely AST practice changes, while 10 (29%) did not.

Figure 11 diplays the percentage of all laboratories that were able to implement timely changes recommended by the CLSI guidelines. The majority of laboratories in all four states were able to implement timely changes,

although the Ultra-low and Low categories had a higher number of laboratories that were unable to make the changes in a timely manner.

Figure 11



When asked what influenced their decisions regarding which antimicrobials to test and report, the CLSI guideline recommendations, the pharmacy and local physicians were the most influential. Of the respondents, 22 (58%) were influenced by the CLSI guidelines, 19 (50%) by the pharmacy, 21 (55%) by local physicians. Other influences included Infection Control practitioners, commercial panels and software formulations, and sales representatives.

The CLSI guidelines were also most influential in the decision to implement changes in AST procedures in laboratories. Twenty-three (61%) of the 38 responding laboratories were influenced by the CLSI guidelines, 4 (11%) by expertise within their own laboratory, 4 (11%) by expert opinions outside of the laboratory, and 3 (8%) were influenced by financial constraints when making their decisions.

Antibiograms

Clinical laboratories were assessed for their ability to create an antibiogram. An antibiogram, as defined by CLSI, is an overall profile of the antibiotic susceptibility of an organism to a collection of antimicrobial agents routinely tested and used. Analysis of antibiograms can reveal potential novel resistance and increases in existing resistance to commonly prescribed antimicrobials against an organism, and aid clinicians in the empiric treatment of infections prior to the availability of specific antimicrobial susceptibility results. Standardization in the construction of an antibiogram is necessary to avoid misinterpretation of data and inappropriate prescribing of empiric antimicrobial therapy.[1]

This survey revealed that twenty-six (68%) of the responding 38 laboratories created antibiograms and in 22 (58%) of the cases, the laboratory was responsible for generating the cumulative antibiogram for select organisms and drug combinations. The majority of the laboratories (85%) rely on automated instrument printouts as a resource for generating this cumulative antibiogram. As recommended, 19 (73%) removed surveillance isolates from their cumulative antibiogram results and 20 (77%) removed multiple isolates from the same patient episode. When looking at the Northern Plains region, 66% of the responding laboratories removed surveillance isolates from their cumulative antibiogram and 70% removed multiple isolates

When assessing the frequency of producing a cumulative antibiogram, eighteen (69%) of the 26 laboratories in Montana compiled cumulative antibiograms yearly, 6 (23%) quarterly, and 2 (8%) monthly. Twelve (46%) of the laboratories preparing antibiograms shared their cumulative antibiograms with the state public health laboratory and 12 (46%) did not.

For the 12 (32%) laboratories unable to create antibiograms, the chief barriers were lack of electronic data collection, lack of laboratory staff, lack of time, and lack of a substantial number of specimens Laboratory capacity was strongly correlated with how readily antibiograms are created, with High capacity laboratories creating the most, and Ultra-low capacity laboratories completing the least number . (Figures 12 and 13)

Figure 12

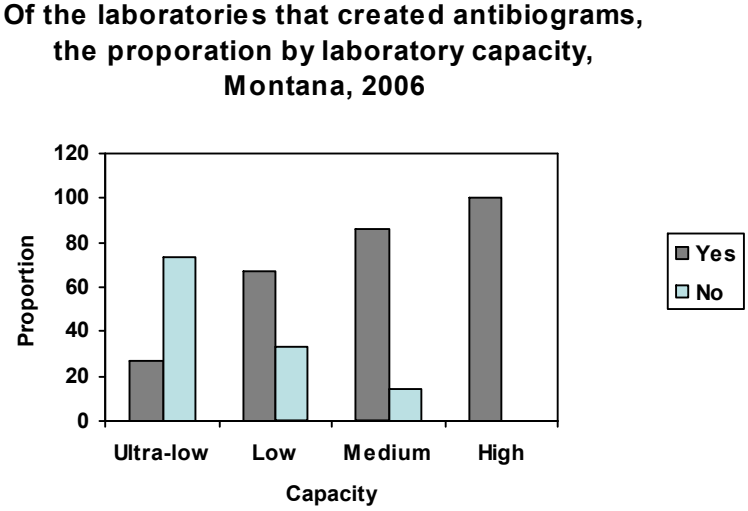
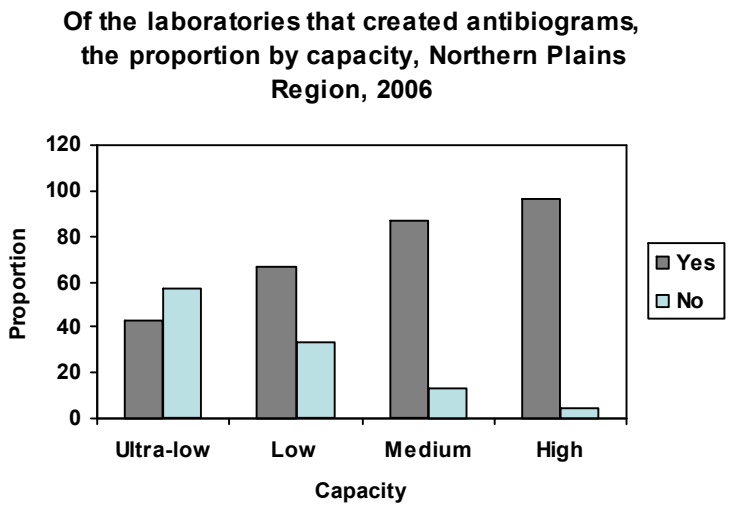


Figure 13



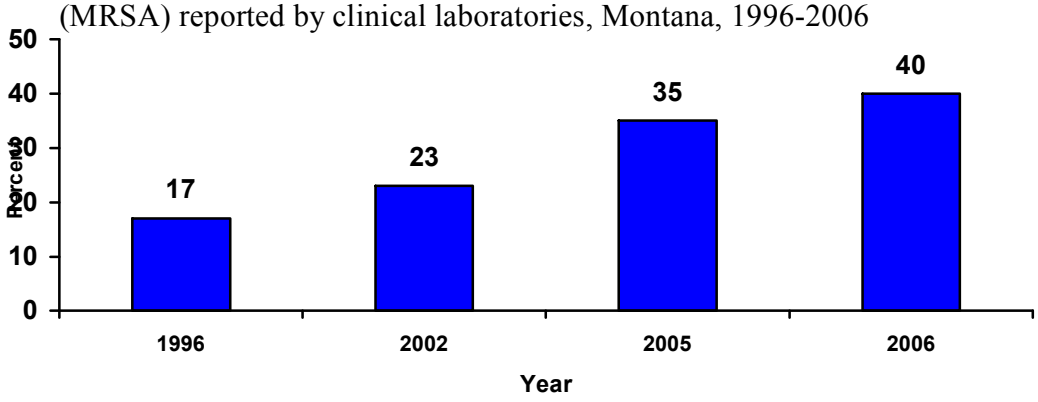
The state-level antibiogram can provide an important perspective for Montana clinicians and public health practitioners. Because the state-level antibiogram represents the results of individual bacteriologic cultures, some of which may be duplicate or follow-up cultures for the same individual patient infection, the data should be used from the surveillance perspective and not as the sole basis for making decisions regarding antimicrobial therapy for an individual patient. Clinicians should review antimicrobial resistance (AMR) profiles maintained

at local hospitals and consult with infectious disease specialists in order to make informed decisions for antimicrobial choice for individual patients.[1]

Methicillin-resistant *Staphylococcus aureus* MRSA infections have been recognized as a problem both in health care settings and, more recently, in the community. The statewide antibiogram indicates that Montana, like the nation, has experienced an increase in the proportion of clinical *S. aureus* isolates documented to be resistant to methicillin (Figure 14).

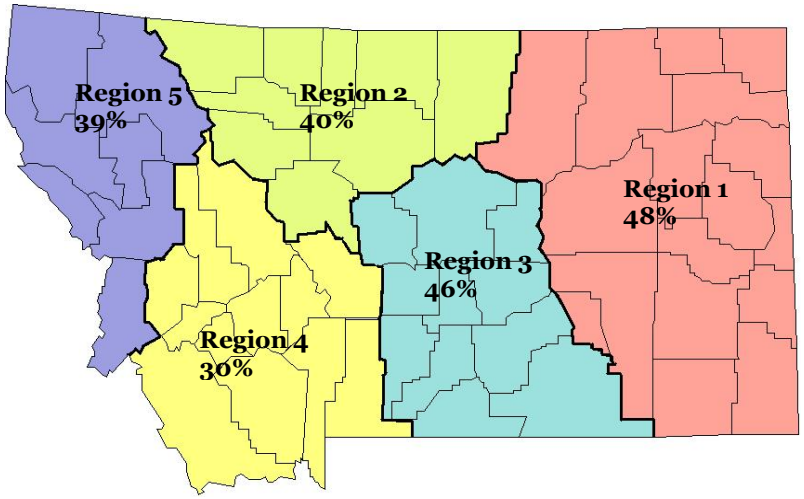
Figure 14

Percent of Staphylococcus aureus isolates resistant to methicillin (MRSA) reported by clinical laboratories, Montana, 1996-2006



The proportion of *S. aureus* documented to be MRSA has varied by geographic region in Montana (Figure 15).

Figure 15 **Proportion of *Staphylococcus aureus* isolates resistant to methicillin (MRSA) by Health Planning Region, Montana, 2006**



In each of the previous AST surveys (1997, 2003, and 2006) there were several *Staphlococcus aureus* isolates reported as resistant to vancomycin. In the 1997 survey, containing 1996 data, there were 11 vancomycin resistant *S. aureus* (VRSA) isolates reported from the 13 responding laboratories. In the 2003 survey,

containing 2002 data, there were 6 VRSA isolates reported from the 20 responding laboratories, and in the 2006 survey, containing 2005 data, there were 3 VRSA isolates reported from the 36 responding laboratories. Again in the 2007 survey, containing 2006 data, there were 3 VRSA isolates reported from the 25 responding laboratories. None of these isolates were ever sent to a reference laboratory for confirmation.

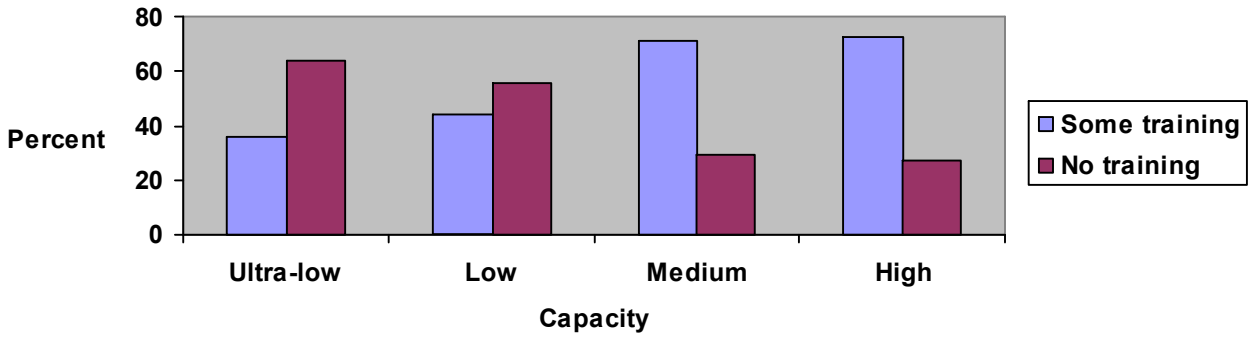
The importance of proper standardized identification and referral practices cannot be overstated. Misinterpretation of data can lead to inappropriate prescribing of empiric antimicrobial therapy, which may be detrimental to patient health and misleading for public health surveillance purposes.

Training

This section assessed the training received by laboratory staff members regarding AST and the resources available for training opportunities. Seventeen (45%) of the 38 responding laboratories did not have AST training provided to laboratory staff. Training was provided at least once a year in only 11 (29%) of the laboratories, 7 (18%) provided training when new staff members were trained, and 3 (8%) provided training less than once a year. The Ultra-low and Low capacity laboratories did not receive as much training as the Medium and High capacity laboratories in 2006. (Figure 16) In the Northern Plains region, 61% of all of the responding laboratories provided some type of training, while 39% did not provide any training or did not know.

Figure 16

Percent of laboratories receiving AST training, Montana, 2006, by capacity



The survey also asked what training methods were currently being used. There was a variety of answers from the 38 laboratories, but the top three training methods being used were: 11 (29%) Teleconference, 11 (29%) On-site training, and 9 (24%) Self study. When compared to preferred methods of training for the future there was not a significant difference from the current methodology. The top three training methods preferred for the future were evenly split. Eight (21%) laboratories preferred Teleconferences, 8 (21%) preferred Self Study, and

8 (21%) preferred Lectures on a CD Rom. Five (13%) preferred Videotaped lectures and 5(13%) preferred On-site trainings.

Because of the distances involved to access or deliver training in Montana, the ability to travel to obtain training was assessed. There were various responses regarding how long clinical laboratorians would be willing or able to travel to attend a training session. The majority of respondents would prefer to only travel two hours, although many would still travel for 3 or 4 hours, and over half would be willing to attend a weekend training. In assessing management support for training, almost half of the respondents were sometimes allowed time off for training, with 14 (37%) allowed time off to attend continuing education off site. Eighteen (48%) of the laboratories allowed staff members time away from the bench to participate in continuing education on-site, and 14 (37%) were sometimes allowed time away. Twenty-seven (71%) did not have a person designated to provide AST training to staff.

Testing Methodology

This section assessed the various methods used in laboratories performing AST testing. It also contained nine knowledge-based questions, which provided various scenarios that were intended to assess laboratory methodology and/or the clinical laboratorian's knowledge of proper AST practices.

The majority of laboratories in Montana perform AST using MIC methodology, either automated or manually read. Of the 38 responding laboratories, 34 (90%) used MIC methodology and 14 (37%) used disk diffusion methodology. In the Northern Plains region, 89% of the laboratories used MIC methodology. Because mixed cultures can skew AST results, and MIC methods do not allow for visual checking of purity, respondents were asked about their purity plate practices. Twenty-two (65%) of the 34 laboratories performing AST by MIC always included a purity plate, 8 (24%) sometimes included a purity plate, and 4 (12%) laboratories indicated they never include a purity plate. The actual reporting of MIC results varied among the laboratories. The majority, 29 (85%), of the laboratories reported MICs by MIC results and CLSI interpretation (i.e., susceptible, intermediate, or resistant). Three (9%) reported MIC results based on CLSI interpretation only and 2 (6%) reported results based on the MIC results only.

Although a purity plate for disk diffusion may not be as important since many times clinical laboratorians can visually assess the purity on the actual AST plate, it is still considered good laboratory practice. Of the 14 laboratories using disk diffusion methodology to perform AST, 4 (29%) always included a purity plate, 6 (43%) sometimes included a purity plate, and 4 (29%) never included a purity plate. Reporting practices differ with Disk Diffusion as well, as eight (57%) reported disk diffusion results based on the diameter of the zone of

inhibition and the CLSI interpretation, while 5 (36%) reported based on CLSI interpretation only, and 1 (7%) reported based on the diameter of the zone of inhibition only.

The nine knowledge-based questions were used to help identify areas of concern that could be addressed in a curriculum of targeted trainings. All answers were available in the current versions of CLSI guidelines, M100 tables, *Performance Standards for Antimicrobial Susceptibility Testing*. Individual laboratory scores were not computed. All of the appropriate antimicrobials had to be selected for the answer to be considered correct.

The first two questions addressed what antimicrobials should be reported when testing fecal isolates of *Salmonella* and *Shigella* spp. from pediatric and adult cases. Four (11%) out of the 38 responding laboratories answered correctly when referring to a pediatric patient and 9 (24%) answered correctly when referring to an adult case.

When asked about which antimicrobials to report as resistant for a confirmed clavulanic-based extended spectrum beta-lactamase (ESBL) isolate, 7 (18%) answered correctly. Sixteen (42%) answered correctly when asked about which antimicrobials to report as resistant for a community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA) strain that is resistant to penicillin and oxacillin, and 16 (42%) answered correctly when asked what a laboratory should do when testing a *Staphylococcus aureus* isolate that is erythromycin resistant and clindamycin susceptible.

When asked what action to take when a rectal surveillance culture for VRE reveals an *Enterococcus spp.* with a vancomycin MIC of 8 mcg/ml, 10 (26%) laboratories answered correctly. Twenty-four (63%) knew the correct action to take when a dialysis patient with nosocomial bacteremia due to MRSA was not responding well on vancomycin, although the culture was susceptible to vancomycin by disk diffusion. When a CSF culture appears to be growing *Streptococcus pneumoniae*, 12 (32%) clinical laboratorians knew the correct susceptibility test to perform and 32 (84%) knew which isolates, or presumptive isolates to refer to a reference laboratory for additional testing/confirmation.

These results indicate there is a gap in knowledge regarding appropriate laboratory response under certain situations. These identified gaps were incorporated into various trainings throughout the year in an effort to better equip clinical laboratorians with the knowledge needed to respond appropriately, and to change practices, if necessary. The use of CLSI guidelines was strongly encouraged throughout these trainings.

Evaluation

There were a few evaluation questions intended to assess where the clinical laboratorians felt improvement was most needed, as well as to allow for any final comments regarding AST or the survey. Seventeen (45%) of the 38 responding laboratories showed interest in learning more about the use of CLSI guidelines, 8 (21%) felt a need for technical/methodology training, 5 (13%) did not perceive any particular training needs, 4 (11%) were interested in training in reporting and other post-analytical aspects, 1 (3%) was interested in having a better understanding of appropriate referral procedures. All of these findings will be taken into consideration for future trainings.

With regard to the interaction between the 38 responding laboratories and the State Public Health Laboratory (SPHL), 23 (61%) of the laboratories would like to see improvement in receiving updates and training in the use of CLSI guidelines from the SPHL, 15 (40%) would like more AST training opportunities offered by the SPHL, 10 (26%) would like more information on utilizing the SPHL as a referral site for problem isolates, 7 (18%) would like more consultative services in regard to AST testing, and 2 (5%) would like more frequent contact with the SPHL.

When asked about the survey design, 11 (29%) of the laboratories felt this survey was important, 20 (53%) felt it was relevant, 14 (37%) felt it was educational, and 13 (34%) felt it was appropriate. Thirty-two (84%) of the respondents would be willing/able to complete a similar survey on the internet (web-based) and 34 (90%) felt the questions were clear.

Conclusions

With the emergence and spread of antimicrobial resistance (AMR), there are an alarming number of illnesses that cannot be easily treated with what were once routine antibiotics. Resistant bacterial pathogens now permeate hospitals, long-term care facilities, and the outpatient community and are a major threat to the public health of our communities. Clinical laboratorians play an important role in the collection, analysis, and circulation of AMR data. Performing high quality diagnostic testing, providing advice regarding treatment of infected patients, and informing Infection Control practitioners when new or problem pathogens have been identified are all vital responsibilities in the effort to prevent and control AMR.

The efficacy of surveillance and control of AMR would be enhanced if all laboratories performing antimicrobial susceptibility testing used standardized guidelines in an effort to provide consistent results. One of the goals of this survey was to assess the laboratory practices and methodologies being utilized throughout the state and to identify areas of concern and barriers to performing high quality AST. A substantial area of concern identified from the survey was a lack of annual AST training. Training is an important aspect of quality performance, as

the recommendations and guidelines for performing ASTs change frequently. The survey further revealed an interest by clinical laboratorians in the use and application of the CLSI guidelines.

The identified areas of concern were used to develop a curriculum for training opportunities which was offered at various times throughout the year. A variety of training opportunities were offered on-site, as well as through distance learning, in an effort to reach as many clinical laboratorians as possible. These trainings covered various topics including which antimicrobials should be routinely included in an AST program and how to create an antibiogram, as well as the importance of antibiogram data, and how to use and apply the CLSI guidelines for quality AST practice. MTPHL also created a short questionnaire to further identify gaps in AST practice regarding isolates of *Salmonella*, *Shigella*, and *E. coli* 0157. These identified gaps were also addressed.

Another area that needs attention gleaned from this survey was how to address the barriers that some laboratories have to creating antibiograms. In an effort to address this barrier, a tool was created as a record keeping device to assist smaller laboratories in tracking antibiogram data manually. These data can then be entered into a monthly worksheet that automatically populates into a cumulative antibiogram. The antibiogram tool was sent to all laboratories that had been unable to submit antibiogram data. As a result, seven (58%) of the 12 laboratories that were unable to complete the antibiogram in 2006 were able to submit their antibiogram data in 2007.

From a public health perspective, this survey collected important data that were used to monitor trends and identify gaps regarding quality antimicrobial susceptibility testing practices and methodology. Appropriate testing practices for AMR are a crucial part of the efforts to recognize and control antimicrobial resistance. In an effort to help laboratories that have challenges in detecting and identifying AMR pathogens, the use of the CLSI voluntary consensus standards and guidelines are strongly recommended. Laboratory professionals are also reminded of the importance of reporting and submitting isolates of AST significance to the Montana Public Health Laboratory (MTPHL), to aid in public health surveillance of antimicrobial resistance patterns.

Creating and sharing antibiograms is also an important step in promoting accurate AMR surveillance and providing high quality patient treatment. The clinical laboratorians' role in recognition and control of AMR pathogens is not only vital to clinicians and infection control, but also plays a major part in protecting the public health of our communities. By addressing the identified barriers to standardization and facilitating the use and practical application of AST standards throughout the state, clinical laboratories will be better equipped to understand and engage in public health related testing, and address the growing concerns over antimicrobial resistance.

References:

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